

Applicants thank the Examiner for the indication of allowable subject matter in claims 3-6, 8, 11, 13, 14 and 16-19, and for the allowance of claims 20 and 21. Please see Appendix I for a marked-up version of the claims. Applicants respectfully request reconsideration of the above-identified application in view of the above amendments and the following remarks.

Claim Rejections Under 35 U.S.C. §112

1. Claims 7 and 10-19 were rejected under 35 U.S.C. §112, second paragraph, as being indefinite. Applicants respectfully traverse the rejection.

Claim 7 was rejected as failing to have proper antecedent basis for the recitation “the convex surface.” As can be seen from the above amendments and the appended marked-up amendments, claim 7 has been amended to depend from claim 2, rather than claim 1. Thus, the recitation “the convex surface” is now provided with proper antecedence, and claim 7 is believed to satisfy the requirements of 35 U.S.C. §112.

Claim 10 was rejected as being unclear. The Examiner stated that it was not clear whether claim 10 is directed to a piston for use in a compressor, or a compressor having a piston. Claim 10 has been amended to recite, “A hollow piston used in a compressor, wherein the piston is adapted to be accommodated in a cylinder bore....” Applicants believe that this amendment sufficiently clarifies claim 10 and renders moot the grounds of rejection. Thus, claim 10 is believed to satisfy the requirements of 35 U.S.C. §112.

Claims 11-19 depend from claim 10 and were rejected for being dependent upon a rejected base claim. Since claim 10, as amended, is believed to satisfy 35 U.S.C. § 112, claims 11-19 are also believed to satisfy 35 U.S.C. §112. Accordingly, Applicants respectfully request for the rejection of claims 7 and 10-19 under 35 U.S.C. §112, second paragraph to be withdrawn

Claim Rejections Under 35 U.S.C. §102

2. Claims 1, 10, 12 and 15 were rejected under 35 U.S.C. §102(b) as being anticipated by Burgdorf (U.S. Pat. No. 3,731,596). Applicants respectfully traverse the rejection.

Burgdorf cannot anticipate claims 1 and 10 because it does not teach each and every element of these claims. See MPEP §2131, p. 2100-69. The Examiner stated:

Burgdorf shows a piston that is not solid (and is therefore considered to be hollow), the piston in figure 1 having a end wall with a flat outer surface exposed to the compressed fluid and an inner surface, the inner surface having a curved surface (near the outer wall) progressing toward a flat surface and then a rising surface (the protrusion) in the center. The limitation in claims 1 and 10 of being used in a compressor is considered intended use, and does not provide for any structure that would overcome the Burgdorf piston.

See Office Action at page 3.

Applicants respectfully submit that the intended use of the piston, as recited in amended claims 1 and 10 and the intended use of the Burgdorf piston result in at least one critical difference in terms of structure. Claim 1 recites a hollow piston used in a compressor, an end wall of the piston having a “substantially flat” outer end face that is exposed to the pressure of the cylinder bore and an inner end face that is opposite to the outer end face. The contour of the inner end face, from the radially outside portion toward the radially inside portion, first approaches the outer end face and then departs from the outer end face to ensure sufficient strength in the end wall against the pressure applied to the outer end face. For the piston of claims 1 and 10 to function, there must be an “*outer end face* that is exposed to the pressure of the cylinder bore,” as recited in amended claims 1 and 10 (emphasis added), so as to compress fluid within the cylinder bore. ✓

In contrast, Burgdorf discloses a piston 8 for a wheel cylinder, as shown in Fig. 1. The piston 8 has an end wall that receives the fluid pressure in a pressure chamber 19. The end wall has an outer end face and an inner end face. A protrusion is formed on the inner end face.

The Burgdorf piston experiences fluid contact *on the inner face of the piston*, which then extends the piston, presumably to compress brake linings for a vehicle or other mechanical device. See Column 1, Line 65 -Column 2, Line 1. Additionally, the surface that experiences the pressure from the fluid in Burgdorf, is in contact with a surface that is not “substantially flat.”

Burgdorf merely discloses the piston of the wheel cylinder for vehicle brakes, but does not disclose a piston used in a compressor. The fluid pressure is applied to the inner end face, and is not applied to the outer end face. Burgdorf also fails to disclose a contour of the inner end face that is suitable for guaranteeing the strength in the end wall against the pressure applied to the outer end face. ✓
X

As mentioned above, Burgdorf does not teach or suggest each and every feature of claims 1 and 10. Thus, claims 1 and 10 are believed to be patentable over the prior art of record, and thus Applicants respectfully request for the rejection of claims 1 and 10 under 35 U.S.C. §102(b) as being anticipated by Burgdorf to be withdrawn.

3. Claims 1, 2, 7 and 9 were rejected under 35 U.S.C. § 102(b) as being anticipated by Heyl (U.S. Pat. No. 4,191,095). Applicants respectfully traverse the rejection. Heyl cannot anticipate claims 1, 2, 7 or 9 because it does not teach each and every element of these claims. See MPEP §2131, p. 2100-69.

Claim 1, as amended recites, *inter alia*, a piston with an end wall having an inner contour that “first approaches the outer end face and then departs from the outer end face *to reinforce the strength of the end wall against the pressure applied to the outer end face.*” Emphasis added.

Heyl discloses a hollow piston for a pump or a motor, as shown in Fig. 1 of Heyl. An end wall 4 of the piston has an outer end face and an inner end face. An annular protrusion is

formed on the inner end face.

The piston of Heyl includes a central post 5. The central post 5 has an axial end that engages with the annular protrusion to support the end wall 4. The end wall 4 has a central bore 9, which communicates with an axial bore 8 of the central post 5. The central bore 9 and the axial bore 8 serve as a fluid passage extending through the piston. This fluid passage renders the Heyl piston unsuitable for a compressor piston that compresses refrigerant gas, and thus, the piston of Heyl cannot be used for a compressor piston. X

Also, the axial end of the central post 5 and the annular protrusion engage with each other to connect the central bore 9 with the axial bore 8 such that fluid does not leak through between the axial end of the central post 5 and the annular protrusion. That is, the annular protrusion is provided for engaging with the central post 5 and sealing the fluid. Heyl does not teach or suggest *the contour of the inner end face* that is suitable "to reinforce the strength of the end wall against the pressure applied to the outer end face," as recited in amended claim 1. Since Heyl does not teach or suggest the above-mentioned features, claim 1, as amended, is believed patentable over the prior art of record. X

Claims 2, 7 and 9 depend from claim 1 and thus incorporate all the features of that claim. Since claim 1 is believed patentable, so too are claims 2, 7 and 9. Accordingly, Applicants respectfully request the rejection of claims 1, 2, 7 and 9, under 35 U.S.C. §102(b) as being anticipated by Heyl to be withdrawn.

4. Claims 22-24 are newly added. Applicants respectfully submit that claims 22-24 are allowable over the prior art of record.

Allowable Subject Matter

5. Applicants thank the Examiner for the indication of allowable subject matter in claims 3-6, 8, 11, 13, 14 and 16-19, and for the allowance of claims 20 and 21.


Applicants have elected not to amend claims 3-6, 8, 11, 13, 14 and 16-19 to be written in independent form, since the above amendments are believed to render moot the grounds of rejection. Thus, all claims as presently presented are believed to be patentable. However, Applicants have added new claims 22, 23 and 24 which are claims 3, 5 and 11 rewritten in independent form, respectively.

Applicants have amended claim 10 and thus, claims 11, 13, 14 and 16-19 to overcome rejections under 35 U.S.C. §112. Thus, these claims are now believed patentable.

CONCLUSION

For these reasons, it is believed that all claims as presently presented are patentable, and that this application is in allowable condition.

Respectfully submitted,


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APPENDIX I

Please amend claims 1, 7 and 10 as follows:

1. (Amended) A hollow piston used in a compressor, wherein the piston has an end wall that receives the pressure of a cylinder bore of the compressor, the end wall having a substantially flat outer end face that is exposed to the pressure of the cylinder bore and an inner end face that is opposite to the outer end face, wherein the contour of the inner end face, from the radially outside portion toward the radially inside portion, first approaches the outer end face and then departs from the outer end face to reinforce the strength of the end wall against the pressure applied to the outer end face.

7. (Amended) The piston according to claim [1] 2, wherein the convex surface is annular about the axis of the piston, wherein the inner end face includes a flat surface that joins to and is located radially inside the annular convex surface.

10. (Amended) A hollow piston used in a compressor, wherein the piston is adapted to be accommodated in a cylinder bore of the compressor, the piston comprising:

an end wall that receives the pressure of the cylinder bore, the end wall having a substantially flat outer end face that is exposed to the pressure of the cylinder bore and an inner end face that is opposite to the outer end face, wherein a recess is formed in the outer end face; and

a protrusion that is formed on the inner end face to reinforce the strength of the end wall against the pressure applied to the outer end face.

Please add claims 22-24 as follows:

--22. (New) A hollow piston used in a compressor, wherein the piston has an end wall that receives the pressure of a cylinder bore of the compressor, the end wall having a substantially flat outer end face and an inner end face that is opposite to the outer end face, wherein the contour of the inner end face, from the radially outside portion toward the radially inside portion, first approaches the outer end face and then departs from the outer end face,

wherein the inner end face includes an annular concave surface, which is located about the axis of the piston, and a convex surface, wherein the convex surface is located radially inside and is joined to the annular concave surface, wherein the annular concave surface is a smooth curved surface, and wherein the cross section of the concave surface is uniform over the entire circumference about the axis of the piston.--

OK

--23. (New) A hollow piston used in a compressor, wherein the piston has an end wall that receives the pressure of a cylinder bore of the compressor, the end wall having a substantially flat outer end face and an inner end face that is opposite to the outer end face, wherein the contour of the inner end face, from the radially outside portion toward the radially inside portion, first approaches the outer end face and then departs from the outer end face,

wherein the inner end face includes an annular concave surface, which is located about the axis of the piston, and a convex surface, wherein the convex surface is located radially inside and is joined to the annular concave surface, wherein the convex surface is a smooth curved surface, and wherein the cross section of the convex surface is uniform over the entire circumference about the axis of the piston.--

OK

--24. (New) A hollow piston used in a compressor, wherein the piston is adapted to be accommodated in a cylinder bore of the compressor, the piston comprising:

an end wall that receives the pressure of the cylinder bore, the end wall having a substantially flat outer end face and an inner end face that is opposite to the outer end face, wherein a recess is formed in the outer end face; and

a protrusion that is formed on the inner end face to reinforce the end wall, wherein the protrusion is aligned axially with the recess.--

OK